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Excellence Mapping: Bibliometric study of the productivity and the impact of scientific publications of the JRC

Mapping of scientific areas and application areas
Volume 2: Analysis of the JRC collaborations with world academic institutions

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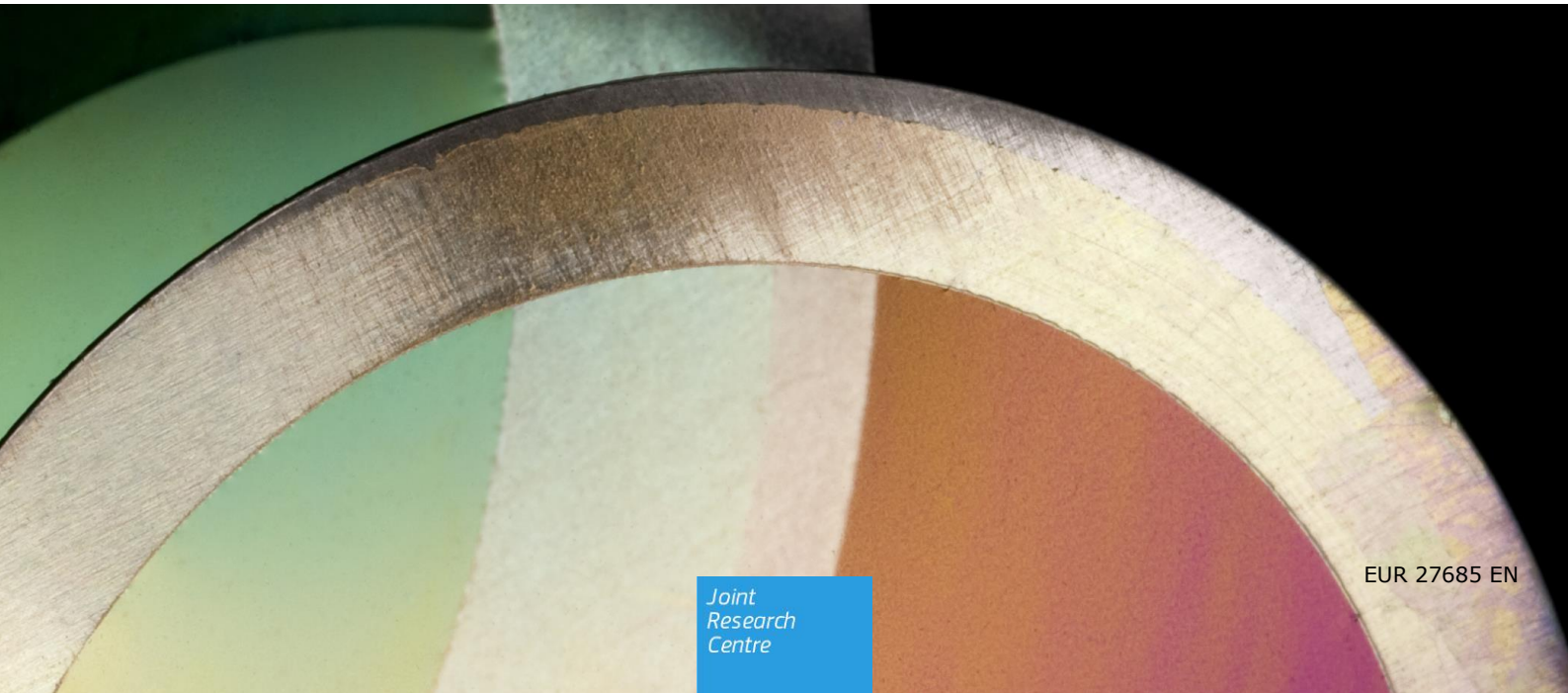

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Joint Research Centre

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Executive summary

The present report is the second volume of the Joint Research Centre (JRC) excellence mapping. While the first volume concentrates on the productivity and the impact of the JRC scientific work, in terms of publications and citations, in general, the present volume analyses a particular subset of publications that have been jointly produced with scientists from other organisations. In particular, it analyses the co-authored publications between the JRC and the academic institutions ([1]), which are highly positioned in different world university rankings.

In the context of this analysis, three different rankings have been used (Times higher education ranking, QS world university ranking and Academic ranking of world universities) and the Top-100 academic institutions in each of them have been analysed in order to investigate: 1) the existence of formal agreements with the JRC; 2) number of co-authored publications with the JRC and 3) the scientific areas where the collaborations occur.

Main findings include the following.

— JRC collaborates actively in the domain of scientific publishing. During 2009-2013 period, over 70 % of all the JRC publications were jointly produced with 1 328 organisations. Of these, around 900 were academic institutions.

— JRC collaborates with the best universities in the world – the organisation co-authored publications with the vast majority (87 %) of the academic institutions ranked among the Top-100 in the three world university rankings mentioned above. The JRC also has formal agreements with almost half (45 %) of the best 100 universities. From these, almost all (96 %) co-authored publications with the JRC.

— The universities with which the JRC collaborates are not only among the best 100 in the world but also highly ranked in terms of absolute number of received citations - over one third of them are found among the Top-15 in the world, in different scientific areas.

— In general, JRC has a high number of collaborators in its domains of high publication productivity.

— However, the number of collaborators with high citation impact, i.e. those here defined as the ones ranked among the Top-15 in terms of absolute number of received citations, is rather low in the areas where JRC publishes the most.

— The highest number of collaborators (about 100) is found in: environmental science, medicine, Earth and planetary sciences. The areas in which the JRC had between 70 and 90 collaborators are: agricultural and biological sciences, physics and astronomy, biochemistry, genetics and molecular biology.

([1]) 'Academic institution' and 'university' are used interchangeably in this document

Table of contents

List of tables and figures

Introduction

The present report is the second volume of the JRC excellence mapping. While the first volume ([2]) concentrates on the productivity and the impact of the JRC scientific work, in terms of publications and citations, in general, the present volume analyses the subset of publications jointly produced with scientists from other organisations, in particular universities.

The excellence mapping is part of a wider effort to produce the evidence base for the following purposes: (i) the ex-post evaluation of the EU Seventh Framework Programme for Research (FP7) (both nuclear and non-nuclear); (ii) the strategic work programme planning (e.g. input for ex ante evaluation thereby closing the annual planning, reporting and evaluation cycle) and (iii) the design of a long term JRC scientific strategy.

The excellence mapping builds on and complements two internal studies: the first one, carried out in 2013, on publications impact ([3]) and collaborations ([4]); and the second, a bibliometric study of JRC research performed by Thomson Reuter in 2014 ([5]).

The initial purpose of the analysis reported in this volume 2 was to provide the first elements of evidence answering the following questions: 1) Which are the 'best' organisations, i.e. the organisations with which the JRC should develop collaboration strategies, partnerships, etc.? 2) Is the JRC collaborating with the 'best' organisations? How do the current JRC collaborators compare to peers in the world?

The present volume of the excellence mapping analyses and benchmarks JRC collaborations in the context of worldwide university rankings. The focus on these university rankings represents a fallback option for the analysis of JRC collaborations, since certain functionalities of the data source tool SciVal® for creating sub-populations of publications were unavailable during several weeks, which forced the author team to conceive and pursue an alternative methodology. Despite this, the fallback option provides interesting insights.

The present report looks at the Top-100 academic institutions in three different worldwide rankings and analyses:

- The existence of a formal agreement with the JRC;
- The number and share of co-authored publications with the JRC;
- The scientific areas corresponding to these joint publications;
- The world rank of the collaborating academic institutions in terms of the absolute number of citations.

([2]) European Commission — Joint Research Centre. (2014). *Excellence Mapping: Bibliometric study of the productivity and the impact of scientific publications of the JRC. Mapping of scientific areas and application areas. Volume 1: General analysis and benchmarking.*

([3]) European Commission — Joint Research Centre. (2013). *Dissemination of JRC scientific results.*

([4]) European Commission — Joint Research Centre. (2013). *JRC collaborations: Analysis of collaborations with universities, public and private research organisations from EU-28 Member States at the level of co-authored scientific peer-reviewed articles (2008-2013)*.

([5]) Thomson Reuter (2014). *Evaluation of the Research Performance of the Joint Research Centre of the European Commission during the 7th Framework Programme (2007-2013)*.

General methodological notes

The excellence mapping volume 2 focuses on the scientific excellence dimension of the publications co-authored by the JRC in collaboration with other organisations, in particular, with academic institutions listed among the Top-100 in three different world university rankings.

Data sources: The principal data sources for the excellence mapping are Elsevier's Scopus® database ([6]) and the associated analytical tool SciVal® ([7]). Scopus® is the largest available citations and abstract database of peer-reviewed scientific literature. Data for the analysis have been extracted during the months of June-September 2014. The analysis covers publications and citations during the period 2009-2013. This time window covers five out of seven years of the duration of FP7, and its use is due to the fact that Elsevier's analytical tool SciVal® provides the required citation information, as well as certain statistical tools and indicators, only for the above-mentioned period.

Scientific areas: In this report, the analysis is performed for the JRC publications as a whole, as well as broken down according to the scientific areas used by the Elsevier's Scopus® database and SciVal® analytical tool. Scopus/SciVal® use three hierarchical levels for the scientific areas: level 1 includes the four overarching scientific areas: life sciences, social sciences, physical sciences and health sciences. Level 2 has 27 scientific areas, which are broken down further into 334 scientific sub-areas of level 3 (referred to hereafter as 'sub-areas'). Since the four level 1 scientific areas are considered to be too broad for the excellence mapping, the general analysis in this study focuses on levels 2 and 3. Further details on scientific areas can be found in the methodological chapter of volume 1 of the excellence mapping.

Selection of 'best' organisations: The joint publications of the JRC with other organisations are analysed in the context of three worldwide university rankings: (1) Times higher education ranking (THES); (2) QS world university ranking (QS) and (3) Academic ranking of world universities (ARWU). The focus on these particular rankings represents the fallback option for the analysis of JRC collaborations, since certain functionalities of the tool SciVal® for creating sub-populations of publications were unavailable during several weeks, which forced the author team to conceive and pursue an alternative methodology. The methodology that was originally planned would have involved benchmarking in the context of the Top-15 organisations regarding selected bibliometric citation indicators similar to the method applied in volume 1 of the excellence mapping. The fallback option also provides interesting insights. Nevertheless, in the interest of analysing and mapping JRC scientific excellence according to one homogeneous methodology, it would be desirable to complete the excellence mapping in general and volume 2 in particular using the original methodology, once the Scopus/SciVal® provide all functions. The original methodology is described in Annex 5.

Comparison with other studies: The bibliometric study performed by Thomson Reuters (see Introduction) used the Thomson Reuters database underlying the Thomson Reuters Web of science research platform. Most publications including those of the JRC are present in both systems, i.e. Web of science and Scopus/SciVal®, but the thematic structure of the information is different. The complementarities between the excellence mapping and the Thomson Reuters report are discussed in Annex 3. This annex also contains a methodological comparison with the JRC internal study on collaborations, in the context of EU-28. Moreover, Annex 4 presents the main findings of all three studies regarding collaborations.

([6]) http://www.scopus.com
([7]) https://www.scival.com

JRC collaborations analysis using pre-defined lists of organisations

This chapter presents results of the analysis of the collaborations, in particular joint publications, between the JRC and some universities highly ranked in different world rankings.

In the context of this analysis, three different rankings have been used and the Top-100 institutions in each of them have been analysed, in order to find out:

- The existence of a formal agreement with the JRC;
- The existence of publications co-authored by the JRC with these institutions;
- The numbers and proportions of joint publications;
- The scientific areas (level 2) corresponding to these joint publications;
- The world rank of these collaborating institutions in terms of the overall number of citations.

1. JRC joint publications with all types of organisations

During the 2009-2013 period, JRC produced 4 962 publications, 71 % of which were co-authored with other organisations. The number of these collaborating organisations amounted to 1 328, of which, roughly 900 were academic institutions.

Table 1: Overall statistics on joint publications produced by the JRC with other organisations, in all scientific areas (2009-2013)

Total number of JRC publications	4 962 ([8])
Total number of co-authored publications	3 523
Proportion of co-authored publications	71 %
Total number of collaborating organisations	1 328

More information on the number of JRC publications, the share of those co-authored with other organisations and the number of collaborators, detailed by scientific area (level 2) and sub-area (level 3), can be found in Annex 2.

([8]) This value is slightly different from the value used in volume 1 of this study (4 929): this difference is explained by the fact that the preparation of the data, including its extraction from the source system (Scopus/SciVal®) was done over several months. In the meantime, the publication numbers corresponding to the JRC changed slightly in the source database.

2. Academic institutions listed in university rankings

Three different university rankings have been used for the present analysis: ARWU, THES and QS. Each of them has a generic version and a version by domain, i.e. life sciences, engineering, social sciences etc. For the current analysis, only their generic version was used and the Top-100 academic institutions in each of them have been analysed.

The following should be noted.

- There are 52 academic institutions which are common to all three university rankings. Some world renowned institutions are ranked among the Top-5 to Top-10 institutions in each of these rankings (Table 2).
- There are 43 institutions which appear in two of the three rankings.
- There are 58 institutions which appear in only one of them.

The three rankings together contain 153 unique academic institutions. List of these institutions and their respective ranking positions can be found in Annex 1.

Table 2: Academic institutions highly ranked in the three analysed world university rankings

Academic institution	University ranking		
	ARWU	THES	QS
Harvard University	1	2	4
Massachusetts Institute of Technology	3	5	1
Stanford University	2	4	7
University of Cambridge	5	7	2
University of Oxford	9	2	5

3. Formal agreements with ranked academic institutions

This section analyses the academic institutions included in the three university rankings and which have concluded formal agreements with the JRC.

The JRC has a formal agreement with 45 % of the academic institutions listed in the three university rankings (68 institutions out of 153 in total). Fifteen of the academic institutions have more than one type of formal agreement with the JRC.

According to data extracted from the JRC internal tool JIPSY ([9]) ([10]) listing scientific bodies with which the JRC has agreements, there are three types of formal agreements between the JRC and academic institutions included in the three rankings: (1) collaboration agreement ([11]), (2) competitive activity ([12]) and (3) institutional network ([13]). Their distribution is depicted in Figure 1.

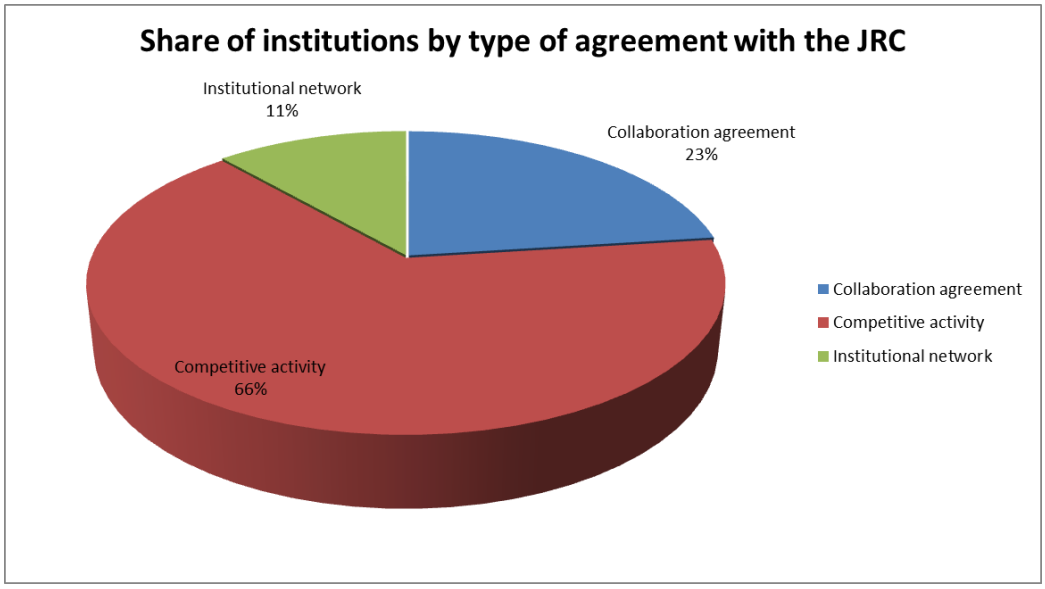

Figure 1: Share of academic institutions by type of agreement with the JRC

The JRC produced joint publications with 96 % of the academic institutions with which a formal agreement has been signed. 38 % of these are ranked among the Top-15 in terms of absolute numbers of citations, in at least one of the scientific areas where collaborations occur.

Only three of the ranked academic institutions have formal agreements with the JRC but no joint publications yet (Ludwig-Maximilians-Universität München (Germany); Ruprecht-Karls-Universität Heidelberg (Germany) and Vrije Universiteit Amsterdam (The Netherlands)).

([9]) JIPSY (JRC integrated processing system) is the JRC interface with ABAC, the Commission's accounting system.

([10]) Two exports dated June and October 2014 were done. These exports do not provide clear information on the overall number of agreements that the JRC has concluded with academic institutions across the world.

([11]) A formal collaboration agreement (CA) is signed when the JRC wishes to undertake specific collaboration activities, such as joint activities and projects, with an external partner. The purpose of establishing a CA is to define the content and modalities of the intended activities or projects.

([12]) In Commission terminology, 'competitive activity' refers to administrative arrangements, FP7 indirect actions and to third party work.

([13]) An Institutional Network is a lasting partnership arrangement with external entities sharing a common interest in the implementation of part of the JRC work programme.

4. Joint publications with ranked academic institutions

This section looks at the academic institutions included in the three analysed university rankings that have co-published papers with the JRC irrespective of the fact whether they have a formal agreement with the JRC or not. Table 3 below presents the generic statistics.

It is important to note that 87 % of the academic institutions listed in the three university rankings have produced joint publications with the JRC (133 institutions of 153 in total), while the vast majority (96 %) of the 52 academic institutions that appear in all three university rankings have produced joint publications with the JRC.

Table 3: Overall statistics on joint publications produced by the JRC with the academic institutions listed in the three analysed world university rankings

Total number of academic institutions collaborating with JRC	133
Raw sum of co-authored publications (i.e. collaborations)	2 226
Estimated number of unique publications ([14])	781
Co-authored publications as a proportion of the total number of JRC publications	16 %
Co-authored publications as a proportion of the total number of JRC co-authored publications	22 %

([14]) This estimation was calculated based on the average number of institutions per co-authored publication by using JRC collaboration information (i.e. number of joint publications and number of collaborating institutions) in all scientific areas (level 2). Estimation was necessary because the SciVal analytical tool does not provide any readily available or easily extractable pre-processed publications sets and/or publications numbers for a given group of organisations of interest for the user. In order to obtain such custom-tailored datasets/numbers, additional processing of larger datasets extracted from SciVal is necessary. Such additional processing was beyond the scope of this initial study.

5. Collaborations by scientific area (level 2)

Figure 2 displays the distribution of the JRC collaborating academic institutions included in the three world university rankings, by scientific area of level 2. A collaborator is an institution included in the three world rankings and which has joint publication(s) with the JRC.

The areas in which the JRC had almost or more than 100 collaborators are:

- environmental science,
- medicine,
- Earth and planetary sciences.

The areas in which the JRC had between 70 and 90 collaborators are:

- agricultural and biological sciences,
- physics and astronomy,
- biochemistry, genetics and molecular biology.

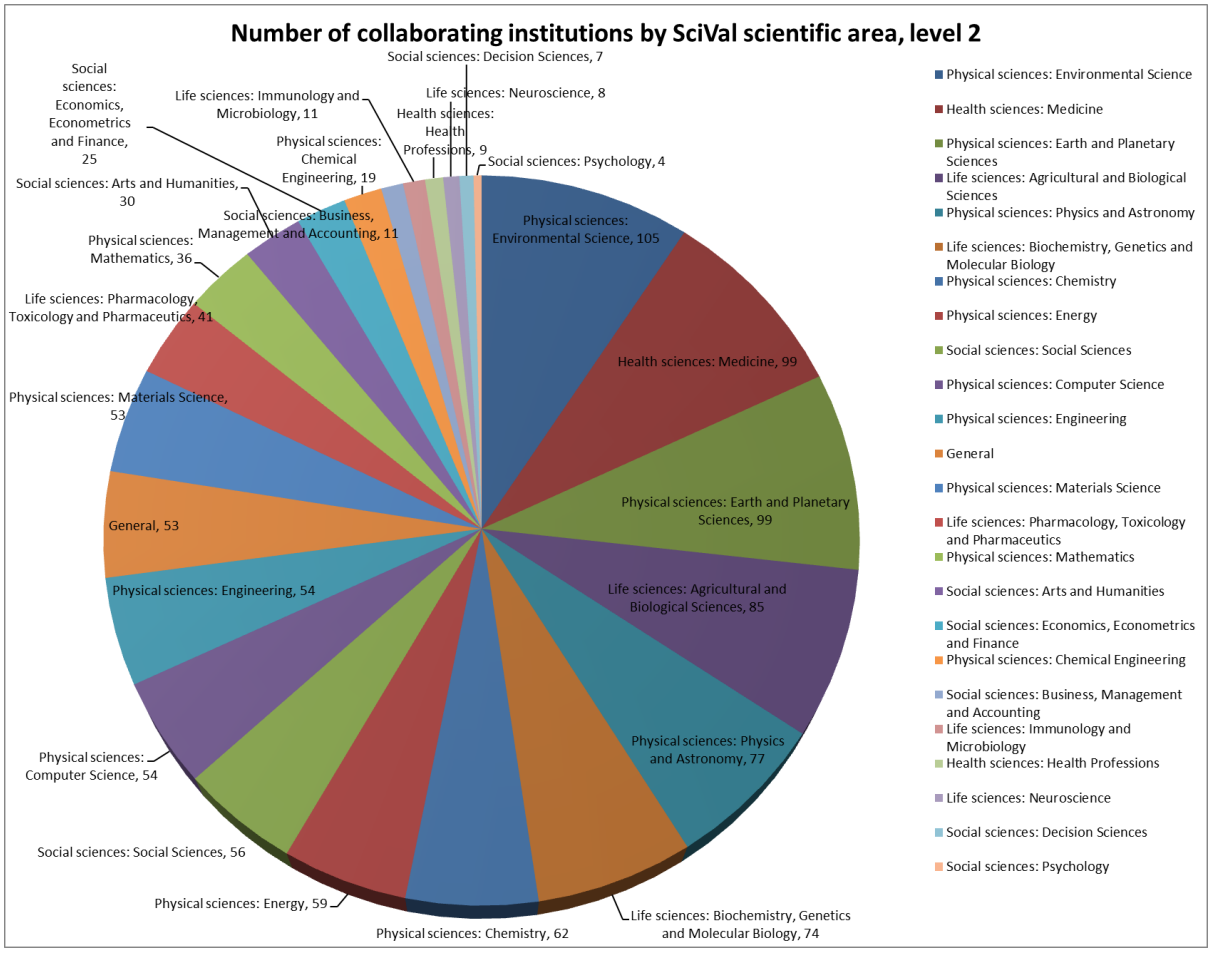

Figure 2: Number of JRC collaborating academic institutions included in the three analysed world university rankings, by scientific area (level 2)

NB: The titles of the scientific areas of level 2 listed in the graph are preceded by one of the four corresponding areas of level 1

Table 4 presents the JRC collaborators (included in the three analysed university rankings) which have the highest numbers of joint publications with the JRC, by scientific area of level 2. Annex 1 presents the overall number of joint publications with the JRC produced by each ranked academic institution in all scientific areas taken together.

Table 4: Top JRC collaborators included in the three analysed world university rankings, by scientific area (level 2)

General	Physical sciences: Computer Science
Columbia University	Lund University
ETH Zurich (Swiss Federal Institute of Technology)	Wageningen University and Research Center
Harvard University	Physical sciences: Energy
McMaster University	Delft University of Technology
University of Edinburgh	Physical sciences: Engineering
Wageningen University and Research Center	Imperial College London
Health sciences: Health Professions	Physical sciences: Environmental Science
John Hopkins University	ETH Zurich (Swiss Federal Institute of Technology)
Health sciences: Medicine	Wageningen University and Research Center
Columbia University	Physical sciences: Material Science
Harvard University	Delft University of Technology
John Hopkins University	Imperial College London
Lund University	Social sciences: Arts and Humanities
University of Munich	Columbia University
Wageningen University and Research Center	Duke University
Life sciences: Agricultural and Biological Sciences	Monash University
Lund University	University of Bristol
Wageningen University and Research Center	University of Edinburgh
Life sciences: Biochemistry, Genetics and Molecular Biology	University of Leeds
Ghent University	University of Melbourne
Lund University	Social sciences: Business, management and Accounting
Wageningen University and Research Center	University of Manchester
Life sciences: Immunology and Microbiology	Utrecht University
Wageningen University and Research Center	Social sciences: Decision Sciences
Life sciences: Neuroscience	Lund University
John Hopkins University	Social sciences: Economics, Econometrics and Finance
University of Bonn	Ecole Polytechnique
University of Munich	University of Copenhagen
University of Zurich	University of Groningen
Life sciences: Pharmacology, Toxicology and Pharmaceutics	University of Manchester
John Hopkins University	Wageningen University and Research Center
Wageningen University and Research Center	Social sciences: Social Sciences
Physical sciences: Chemical Engineering	Delft University of Technology
Imperial College London	University of Leeds
Physical sciences: Computer Science	Wageningen University and Research Center
Wageningen University and Research Center	

NB: The titles of the scientific areas of level 2 mentioned in the table above are preceded by one of the four corresponding areas of level 1.

Over one third of the 153 collaborating academic institutions (listed in the three analysed rankings) are found among the Top-15 in the world, in terms of absolute number of citations in different scientific areas (Table 5 below). In the ten most important areas for the JRC, in terms of number of citations (as demonstrated in excellence mapping volume 1), the number of collaborating academic institutions found among the Top-15 ranges from five to ten.

Table 5: Number of JRC collaborators listed in the three analysed world university rankings that are ranked Top-15 in the world, in terms of absolute number of citations, by scientific area (level 2)

SciVal scientific areas, level 2	Number of JRC collaborators ranked Top 15 in the world, in terms of number of citations
Social sciences: Arts and Humanities	12
Physical sciences: Mathematics	11
Social sciences: Psychology	11
Social sciences: Social Sciences	11
General	10
Health sciences: Health Professions	10
Health sciences: Medicine	10
Life sciences: Neuroscience	10
Physical sciences: Engineering	10
Physical sciences: Materials Science	10
Social sciences: Business, Management and Accounting	10
Social sciences: Decision Sciences	10
Social sciences: Economics, Econometrics and Finance	10
Health sciences: Nursing	9
Life sciences: Biochemistry, Genetics and Molecular Biology	9
Life sciences: Immunology and Microbiology	9
Physical sciences: Chemical Engineering	9
Physical sciences: Computer Science	9
Life sciences: Agricultural and Biological Sciences	8
Physical sciences: Chemistry	8
Physical sciences: Physics and Astronomy	8
Health sciences: Veterinary	7
Life sciences: Pharmacology, Toxicology and Pharmaceutics	7
Physical sciences: Earth and Planetary Sciences	6
Physical sciences: Environmental Science	6
Physical sciences: Energy	5

Conclusions

The analysis presented in this document provides the very first elements characterising the current scientific collaborations of the JRC. Several conclusions could be drawn.

- JRC collaborates actively in the domain of scientific publishing. During 2009-2013 period, over 70 % of all the JRC publications were jointly produced with 1 328 organisations. Of these, around 900 were academic institutions.

- JRC collaborates with the best universities in the world – the organisation co-authored publications with the vast majority (87 %) of the academic institutions ranked among the Top-100 in the three world university rankings mentioned above. The JRC also has formal agreements with almost half (45 %) of the best 100 universities. From these, almost all (96 %) co-authored publications with the JRC.

- The universities with which the JRC collaborates are not only among the best 100 in the world but also highly ranked in terms of absolute number of received citations - over one third of them are found among the Top-15 in the world, in different scientific areas.

- In general, JRC has a high number of collaborators in its domains of high publication productivity.

- However, the number of collaborators with high citation impact, i.e. those here defined as the ones ranked among the Top-15 in terms of absolute number of received citations, is rather low in the areas where JRC publishes the most.

- The highest number of collaborators (about 100) is found in: environmental science, medicine, Earth and planetary sciences. The areas in which the JRC had between 70 and 90 collaborators are: agricultural and biological sciences, physics and astronomy, biochemistry, genetics and molecular biology.

As initially planned, this analysis could be interestingly complemented by a wider study of current and potential JRC collaborators. In particular, an in-depth study of the current and potential JRC collaborators could analyse their scientific areas of research, their scientific excellence (using different rankings), their number of joint publications, the number and the scientific excellence of their collaborating institutions. The methodology for a complementary study of JRC collaborations is described in Annex 5.

Annex 1: Academic institutions included in the three analysed university rankings

Table 6: List of the 52 academic institutions common to the three analysed world university rankings, their ranking position and number of JRC joint publications

Institution name	THES ranking position	QS ranking position	ARWU ranking position	Total number of co-authored publications (all areas) 2009-2013 Source: SciVal
Australian National University	48	25	74	17
Boston University	50	78	72	7
Brown University	52	53	74	
California Institute of Technology	1	8	7	30
Carnegie Mellon University	24	66	62	4
Columbia University	13	14	8	32
Cornell University	19	19	13	23
Duke University	17	26	31	10
École Normale Supérieure	65	24	67	3
ETH Zurich (Swiss Federal Institute of Technology)	14	12	19	39
Harvard University	2	4	1	30
Imperial College London	10	3	22	38
Johns Hopkins University	15	15	17	33
King's College London	38	16	59	23
KU Leuven	61	82	96	42
Kyoto University	52	36	26	6
Leiden University	67	75	77	10
Massachusetts Institute of Technology (MIT)	5	1	3	13
McGill University	35	21	67	4
New York University	40	41	27	7
Northwestern University	22	34	28	
Princeton University	6	9	6	18
Stanford University	4	7	2	13
Technical University Munich	87	54	53	37
University of Manchester	58	30	38	17
University of Melbourne	34	33	44	27
The University of Tokyo	23	31	21	36
University College London	21	6	20	15
University of Bristol	79	29	63	17
University of British Columbia	31	43	37	9
University of California, Berkeley	8	27	4	8
University of California, Davis	52	95	55	14
University of California, Los Angeles	12	37	12	27
University of California, San Diego	40	59	14	1
University of Cambridge	7	2	5	41
University of Chicago	9	11	9	14
University of Edinburgh	39	17	45	38
University of Groningen	98	90	82	14
University of Helsinki	100	67	73	42
University of Illinois at Urbana Champaign	29	63	28	10
University of Michigan	18	23	22	22
University of North Carolina at Chapel Hill	47	62	36	12
University of Oxford	2	5	9	24
University of Pennsylvania	16	13	16	3
University of Queensland	63	44	85	7
University of Texas at Austin	27	79	39	3
University of Toronto	20	20	24	6
University of Washington	25	65	15	18
University of Wisconsin-Madison	30	42	24	17
Utrecht University	74	80	57	39
Washington University in St. Louis	42	99	32	1
Yale University	11	10	11	9

Table 7: List of the 43 institutions that appear in two of the three analysed world rankings, their ranking position and the number of JRC joint publications

Institution name	THES ranking position	QS ranking position	ARWU ranking position	Total number of co-authored publications (all areas) 2009-2013 Source: SciVal
Aarhus University		96	74	51
Delft University of Technology	69	86		36
Durham University	80	93		
Ecole Polytechnique	70	35		8
École Polytechnique Fédérale de Lausanne	37	18		12
Erasmus University Rotterdam	73	91		8
Georgia Institute of Technology	28		99	2
Ghent University	85		70	50
Heidelberg University	68		49	36
KAIST - Korea Advanced Institute of Science & Technology	56	51		1
Karolinska Institute	36		47	5
London School of Economics and Political Science (LSE)	32	72		6
Ludwig-Maximilians-Universität München	55	52		
McMaster University	92		90	14
Monash University	91	70		8
Nanyang Technological University	76	39		2
National University of Singapore (NUS)	26	22		1
Ohio State University	59		64	8
Osaka University		55	78	1
Peking University	45	57		11
Pennsylvania State University	49		58	13
Pohang University of Science and Technology (Postech)	60	87		
Purdue University	62		60	2
Rice University	65		82	2
Seoul National University	44	32		5
The University of Western Australia		89	88	4
Tsinghua University	50	47		5
Université Pierre et Marie Curie	96		35	50
University of Amsterdam	83	50		6
University of Basel	74		90	48
University of California, Irvine	93		47	19
University of California, Santa Barbara	33		41	15
University of Colorado at Boulder	97		34	36
University of Copenhagen		45	39	34
University of Geneva		85	66	3
University of Hong Kong	43	28		3
University of Minnesota	46		30	10
University of Pittsburgh	78		65	
University of Rochester	95		90	3
University of Southern California	70		51	5
University of Zurich		58	56	18
Uppsala University		81	60	20
Vanderbilt University	88		54	1

Table 8: List of the 58 academic institutions that appear in only one of the three analysed world university rankings, their ranking position and the number of JRC joint publications

Institution name	THES ranking position	QS ranking position	ARWU ranking position	Total number of co-authored publications (all areas) 2009-2013 Source: SciVal
Arizona State University			88	5
Case Western Reserve University	88			
Emory University	80			2
Freie Universität Berlin	86			9
Fudan University		71		3
Georg-August-Universität Göttingen	63			
Hebrew University of Jerusalem			70	8
Hong Kong University of Science and Technology	57			
Humboldt-Universität zu Berlin	94			6
Lund University		60		49
Maastricht University	98			3
Michigan State University	83			19
Moscow State University			84	8
National Taiwan University (NTU)		76		2
Queen Mary University of London (QMUL)		96		5
Rockefeller University			33	
Ruprecht-Karls-Universität Heidelberg		49		
Rutgers, The State University of New Jersey - New Brunswick			52	7
Stockholm University			78	26
Swiss Federal Institute of Technology Lausanne			96	
Technion-Israel Institute of Technology			78	1
Texas A and M University			96	8
The Chinese University of Hong Kong		46		2
The Hong Kong University of Science and Technology		40		
The University of Adelaide		100		
The University of Auckland		92		4
The University of New South Wales		48		16
The University of Nottingham		77		11
The University of Sheffield		69		16
The University of Sydney		38		4
The University of Texas Southwestern Medical Center at Dallas			45	
The University of Warwick		61		2

Table 8 (continued): List of the 58 academic institutions that appear in only one of the three analysed world university rankings, their ranking position and the number of JRC joint publications

Institution name	THES ranking position	QS ranking position	ARWU ranking position	Total number of co-authored publications (all areas) 2009-2013 Source: SciVal
Tohoku University		73		
Tokyo Institute of Technology		68		2
Trinity College Dublin		74		7
Tufts University	80			
Université de Montréal		83		3
University of Alberta		84		7
University of Arizona			86	25
University of Birmingham		64		10
University of Bonn			94	89
University of California, San Francisco			18	14
University of California, Santa Cruz			93	15
University of Florida			78	22
University of Glasgow		56		16
University of Leeds		97		12
University of Maryland, College Park			43	14
University of Munich			49	2
University of Notre Dame	90			32
University of Oslo			69	18
University of Paris Sud (Paris 11)			42	17
University of Southampton		94		4
University of St Andrews		88		
University of Strasbourg			95	19
University of Sydney	72			4
University of Utah			87	
VU University Amsterdam			100	
Wageningen University and Research Center	77			134

Annex 2: General JRC joint publications information, by scientific area (level 2) and sub-area (level 3)

Table 9: JRC joint publications, by scientific area (level 2) and sub-area (level 3)

SciVal area (level 2) / sub-area (level 3)	JRC			
	Total publications	Co-authored publications	Proportion of co-authored publications	Number of collaborators
Environmental science	1294	881	68%	728
General environmental science	278	197	71%	401
Waste Management and Disposal	207	119	57%	147
Environmental chemistry	205	138	67%	291
Management, monitoring, policy and law	203	135	67%	163
Pollution	190	132	69%	206
Health, toxicology and mutagenesis	156	102	65%	199
Ecology	145	110	76%	217
Water Science and Technology	102	73	72%	135
Ecological modelling	53	43	81%	61
Physics and astronomy	1085	843	78%	523
Nuclear and high energy physics	360	279	78%	230
Condensed matter physics	315	247	78%	281
Instrumentation	175	121	69%	146
Atomic and molecular physics, and optics	113	81	72%	177
Radiation	90	64	71%	113
Engineering	924	570	62%	427
Electrical and Electronic Engineering	289	179	62%	196
Safety, Risk, Reliability and Quality	261	139	53%	109
Mechanical Engineering	209	139	67%	119
Mechanics of Materials	103	71	69%	79
Industrial and Manufacturing Engineering	88	52	59%	54
Civil and Structural Engineering	82	59	72%	58
Earth and Planetary Sciences	816	628	77%	623
Atmospheric Science	299	250	84%	419
General Earth and Planetary Sciences	217	142	65%	218
Computers in Earth Sciences	90	66	73%	103
Earth and Planetary Sciences (miscellaneous)	74			
Oceanography	64	51	80%	125
Geophysics	61	51	84%	143
Geology	46	39	85%	96
Space and Planetary Science	45	40	89%	132
Geotechnical Engineering and Engineering Geology	45	26	58%	34
Agricultural and Biological Sciences	637	494	78%	538
Aquatic Science	140	126	90%	216
Ecology, Evolution, Behavior and Systematics	128	109	85%	259
Food Science	118	67	57%	77
Agronomy and Crop Science	113	88	78%	137
Soil Science	85	73	86%	163
Forestry	84	67	80%	130
Energy	640	395	62%	340
Nuclear Energy and Engineering	349	231	66%	172
Energy Engineering and Power Technology	150	102	68%	95
Renewable Energy, Sustainability and the Environment	137	87	64%	181
General Energy	112	47	42%	57
Fuel Technology	79	58	73%	65
Chemistry	601	416	69%	392
General Chemistry	223	148	66%	216
Analytical Chemistry	206	129	63%	171
Physical and Theoretical Chemistry	125	97	78%	102
Spectroscopy	113	76	67%	120
Organic Chemistry	45	32	71%	37
Inorganic Chemistry	42	33	79%	38

Table 9 (continued): JRC joint publications, by scientific area (level 2) and sub-area (level 3)

SciVal area (level 2) / sub-area (level 3)	JRC			
	Total publications	Co-authored publications	Proportion of co-authored publications	Number of collaborators
Computer Science	592	334	56%	292
Computer Science Applications	198	120	61%	167
Computer Networks and Communications	174	87	50%	97
Software	125	73	58%	78
General Computer Science	79	37	47%	47
Information Systems	69	40	58%	52
Materials Science	564	418	74%	324
General Materials Science	331	228	69%	201
Electronic, Optical and Magnetic Materials	142	114	80%	164
Materials Chemistry	83	70	84%	87
Surfaces, Coatings and Films	48	40	83%	67
Social Sciences	393	258	66%	286
Geography, Planning and Development	156	107	69%	161
General Social Sciences	58	43	74%	60
Sociology and Political Science	37	21	57%	28
Development	35	26	74%	50
Law	34	21	62%	36
Library and Information Sciences	27	16	59%	17
Safety Research	23	11	48%	16
Biochemistry, Genetics and Molecular Biology	326	237	73%	392
Biochemistry	112	76	68%	127
General Biochemistry,Genetics and Molecular Biology	69	56	81%	163
Biotechnology	55	34	62%	63
Cancer Research	10	9	90%	15
Medicine	316	231	73%	478
Public Health, Environmental and Occupational Health	106	70	66%	207
General Medicine	94	69	73%	269
Radiology, Nuclear Medicine and Imaging	51	41	80%	71
Biochemistry (medical)	20	19	95%	41
Pharmacology, Toxicology and Pharmaceutics	251	188	75%	260
Toxicology	188	141	75%	213
Mathematics	240	158	66%	231
Applied Mathematics	100	71	71%	115
Modeling and Simulation	62	44	71%	65
Theoretical Computer Science	56	25	45%	31
Computational Mathematics	23	21	91%	26
Statistics and Probability	23	18	78%	24
Chemical Engineering	183	119	65%	152
General Chemical Engineering	113	74	65%	85
Bioengineering	46	25	54%	58
Economics, Econometrics and Finance	149	105	70%	103
Economics and Econometrics	129	94	73%	97
Business, Management and Accounting	102	66	65%	73
Strategy and Management	34	20	59%	21
Management of Technology and Innovation	28	19	68%	35
Business and International Management	26	18	69%	32
Decision Sciences	88	60	68%	62
Immunology and Microbiology	48	38	79%	62
Multidisciplinary	37	32	86%	197
Health Professions	32	28	88%	63
Psychology	24	21	88%	29
Arts and Humanities	22	18	82%	103
Neuroscience	13	10	77%	26
Veterinary	9	5	56%	7
Nursing	2	2	100%	2

Annex 3: Methodological comparison with the Thomson Reuters report and the JRC internal report on collaborations

The table below aims at providing a brief overview of the sample analysed, coverage and indicators used in the Thomson Reuters report ([15]), the JRC (internal) report *JRC collaborations: Analysis of collaborations with universities, public and private research organisations from EU-28 Member States at the level of co-authored scientific peer-reviewed articles (2008-2013*) and the excellence mapping volumes 1 and 2.

Table 10: Comparison of the Thomson Reuters report, the JRC (internal) report on collaborations and the excellence mapping volumes 1 and 2

	Thomson Reuters report	**JRC collaborations with universities from EU-28 Member States**	**Excellence mapping volumes 1 & 2**
Data source	Thomson Reuters and Thomson Reuters Web of science™	PUBSY	Elsevier: Scopus and SciVal
Time period	2007-2013	2008-2013	2009-2013
No of JRC publications	4 436	3 444	4 929
Publications	journals, conferences and books; partial focus on article, article-proceedings paper, review	peer-reviewed journals (PUBSY categories 1.4 and 3.1)	peer-reviewed journals, conference papers, books, trade publications; partial focus on articles
Comparison with	17 organisations selected by the JRC	No	World average; 15 organisations that received the highest number of citations in 26 journal categories of level 2 and 82 journal categories of level 3 => more than 1000 organisations
Indicators	bibliometric; patents; social media	bibliometric	bibliometric

([15]) Thomson Reuter (2014). Evaluation of the Research Performance of the Joint Research Centre of the European Commission during the 7th Framework Programme (2007-2013).

	Thomson Reuters report	JRC collaborations with universities from EU-28 Member States	Excellence mapping volumes 1 & 2
Analytical dimensions:			
productivity	publication output	publication output	publication output
impact	citations; citation per publication; normalised citation impact; average impact factor; countries and organisations citing JRC; social media impact	No	citations; citations per publication; proportion of cited publications; field-weighted citation impact; publications in the top 10 % of the most cited publications; publications in the top 10 % of the most cited journals
Areas analysed and indicators used to determine JRC excellence	20 journal categories and 20 custom subject categories: number of publications; citation impact	No distinction according to scientific areas	26 journal categories and 36 MAWP clusters: share of publications 26 journal categories and 82 journal sub-categories: benchmarking standardised scores for all impact indicators; distance to world average; distance to Top-15
collaborations	Top-10 countries and Top-10 institutions with which JRC co-authored	11 organisations having produced joint publications with the JRC and that are part of the Top-50 organisations of three worldwide university rankings	153 organisations included in three world rankings (THES; QS, ARWU)
innovation	private sector partners; patents citing JRC publications	-	-
researcher mobility	follow-up of authors who published in 2003, 2008 and 2013	-	-
emerging areas	Research Fronts	-	-

The reports are complementary. Yet, where comparable, the results of the studies are coherent, see Annex 4.

Annex 4: Main findings of the Thomson Reuters report, the JRC internal report on collaborations and the excellence mapping volume 2

Conclusions of the excellence mapping volume 2

- JRC collaborates actively in the domain of scientific publishing. During 2009-2013 period, over 70 % of all the JRC publications were jointly produced with 1 328 organisations. Of these, around 900 were academic institutions.
- JRC collaborates with the best universities in the world – the organisation co-authored publications with the vast majority (87 %) of the academic institutions ranked among the Top-100 in the three world university rankings mentioned above. The JRC also has formal agreements with almost half (45 %) of the best 100 universities. From these, almost all (96 %) co-authored publications with the JRC.
- The universities with which the JRC collaborates are not only among the best 100 in the world but also highly ranked in terms of absolute number of received citations - over one third of them are found among the Top-15 in the world, in different scientific areas.
- In general, JRC has a high number of collaborators in its domains of high publication productivity.
- However, the number of collaborators with high citation impact, i.e. those here defined as the ones ranked among the Top-15 in terms of absolute number of received citations, is rather low in the areas where JRC publishes the most.
- The highest number of collaborators (about 100) is found in: environmental science, medicine, Earth and planetary sciences. The areas in which the JRC had between 70 and 90 collaborators are: agricultural and biological sciences, physics and astronomy, biochemistry, genetics and molecular biology.

Conclusions from Thomson Reuters report regarding joint publications with other organisations

- The top collaborative countries, in terms of number of joint publications, are from Europe, led by Germany (860 publications), 2007-2013.
- The JRC publications in collaboration with the United States resulted in the highest impact in 2007-2013.
- JRC collaborations with Sweden and Switzerland had a relatively high impact in 2007-2013.
- The United States led the trend in citation impact among the Top-10 countries in 2007-2013.
- The impact of collaborations with Spain and Belgium consistently ranked ninth and tenth among the Top-10 most productive collaborative countries, 2007-2013.

— Seven of the Top-10 institutions that collaborate with the JRC are located in the Netherlands, France and the United States, 2007-2013.

— Wageningen University and Research Centre had a strong collaboration with the JRC in 2007-2013.

— Publications resulting from the collaboration between JRC and the French National Institute of Agronomic Research (INRA) had the highest normalised impact in 2007-2013.

— Citation impact for collaborative organisations with the JRC trended downwards between 2007 and 2010.

— Four out of ten peer organisations' publications included are from one or more of JRC Top-10 collaborative countries.

— Publications that included JRC Top-10 collaborative countries had a higher normalised citation impact.

Conclusions from the *JRC collaborations: Analysis of collaborations with universities, public and private research organisations from EU-28 Member States at the level of co-authored scientific peer-reviewed articles (2008-2013)*

— Large heterogeneities across EU Member States regarding the collaborations between JRC and universities, partly reflecting the different scientific systems in the various countries. For example, in Member States such as France, most of the collaborations are with national research organisations, reflecting the weight of these organisations as compared to universities, for example. In other countries such as Poland, universities together with national and governmental laboratories have a more balanced share.

— During the reference period 2008-2013, there are in total 399 universities co-writing scientific articles with the JRC, corresponding to some 3 400 collaborations with scientists in universities. Of these 399 universities, 25 represent roughly 1/3 of all university collaborations with the JRC. Germany, Italy and the Netherlands cover 45 % of collaborations among the Top- 25 universities.

— Analysis of the position of the collaborating universities in FP7 comparative studies. Eight of the Top-25 universities collaborating with the JRC can be found in the Top-25 group of the FP7 ranking, and 11 can be found in the Top-50 of the FP7 ranking.

— Putting the JRC Top-25 collaborating universities with various worldwide university rankings, typically four to five universities can be put in the Top-100 universities of the world.

Annex 5: Analysis originally planned for studying JRC collaborations with the 'best' organisations world-wide

Two important questions need to be answered: 1. Which are the 'best' organisations i.e. those with which the JRC should develop collaborating strategies, partnerships, etc.? 2. Is the JRC collaborating with the 'best' organisations? How do the current JRC collaborators rank compared to peers in the world?

A pre-requisite for answering these questions would be to clearly define from the start what is meant by the 'best' organisations.

Given the previous analysis done in the context of the scientific excellence mapping, and for consistency reasons, the 'best' organisations have been defined as those organisations that rank top in terms of numbers of citations. These organisations are called in what follows 'Top-15 most cited organisations'.

Approach proposed: in order to answer the two questions above, the original approach envisaged defining/calculating 'collaboration profiles': (1) firstly for the 'Top-15 most cited organisations' (in order to answer the second question above) taken together; and (2) secondly, for the JRC (in order to answer the first question above).

A 'collaboration profile' is composed of the following two parts.

— A table containing general information, i.e. number of co-authored publications and their share of the total and number of current collaborating institutions, for each scientific area (level 2) and sub-area (level 3) of relevance for the JRC.

Table 11: Sample general table for the scientific area 'environmental science' and associated sub-areas

Area / sub-area	JRC				Top-15 most cited institutions			
	Total publications	Co-authored publications	Proportion of co-authored publications	Nr of collaborators	Total publications	Co-authored publications	Proportion of co-authored publications	Nr of collaborators
Environmental science	1294	881	68%	728	N/A	N/A	N/A	N/A
General Environmental Science	278	197	71%	401	N/A	N/A	N/A	N/A
Waste Management and Disposal	207	119	57%	147	N/A	N/A	N/A	N/A
Environmental Chemistry	205	138	67%	291	N/A	N/A	N/A	N/A
Management, Monitoring, Policy and Law	203	135	67%	163	N/A	N/A	N/A	N/A
Pollution	190	132	69%	206	N/A	N/A	N/A	N/A
Health, Toxicology and Mutagenesis	156	102	65%	199	N/A	N/A	N/A	N/A
Ecology	145	110	76%	217	N/A	N/A	N/A	N/A
Water Science and Technology	102	73	72%	135	N/A	N/A	N/A	N/A
Ecological Modelling	53	43	81%	61	N/A	N/A	N/A	N/A

Note: Data for Top-15 organisations are not available and will be provided when the detailed study will be performed

— A table containing the following.

(a) The overlap between the 'best' organisations and the current collaborators (of the JRC and of the Top-15 most cited organisations taken as a group). In other words, how many current collaborators are among the Top-15 ranked most cited organisations; If easily feasible, it could be interesting to calculate the overlap also with the Top-50 ranked most cited organisations; the Top-100 ranked most cited organisations; (applicable only for current JRC collaborators)

the organisations that rank higher than the JRC in each area/sub-area analysed ('top JRC'); and the Top-500 ranked most cited organisations.

(b) The raw proportion of publications co-authored (by the JRC and by the Top-15 most cited organisations taken as a group, respectively) with organisations which are among the Top-15 ranked most cited organisations. And, if feasible, among the Top-50 ranked most cited organisations; among the Top-100 ranked most cited organisations; among the organisations that rank higher than the JRC in each analysed area/sub-area ('top JRC'); and among the Top-500 ranked most cited organisations.

(c) The weighted proportion of publications co-authored (by the JRC and by the Top-15 most cited organisations taken as a group, respectively) with organisations which are among the Top-15 ranked most cited organisations. And, if feasible, among the Top-50 ranked most cited organisations; among the Top-100 ranked most cited organisations; among the organisations that rank higher than the JRC in each analysed area/sub-area ('top JRC'); and among the Top-500 ranked most cited organisations.

(d) NB: The 'weighted proportion' is based on the association of some weighting factor to the number of co-authored publications, according to the ranking of the collaborators. The principle is: a paper co-authored with a highly ranked organisation should 'weigh' more (i.e. be more important) than a paper co-authored with a low-ranked organisation.

(e) E.g. a publication co-authored with a Top-15 organisation would rank twice higher than a publication ranked with a Top-500 (or lower) organisation.

Table 12: Sample profile table for scientific area 'environmental science' and associated sub-areas

Area / sub-area	Top-15 most cited institutions			Top-50 most cited institutions			Institutions ranked higher than the JRC		
	% current JRC collaborators	% of co-authored publications	Weighted % of co-authored publications	% current JRC collaborators	% of co-authored publications	Weighted % of co-authored publications	% current JRC collaborators	% of co-authored publications	Weighted % of co-authored publications
Environmental science	93%	18%	36%	94%	0%	0%	95%	0%	0%
General Environmental Science	87%	25%	52%	82%	0%	0%	94%	0%	0%
Waste Management and Disposal	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Environmental Chemistry	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Management, Monitoring, Policy and Law	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pollution	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Health, Toxicology and Mutagenesis	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ecology	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Water Science and Technology	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ecological Modelling	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Note: Sub-areas for which data are not available will be provided when the detailed study will be performed

Remarks on feasibility: The creation of blocks of 'Top-15 most cited organisations' by area/sub-area implies the manual creation, within SciVal, of 'groups of organisations'. These groups, given that they are 'custom-made' based on the ranking of organisations in terms of citations numbers, have to be built and requested one by one (and subsequently computed by Elsevier). The computation of these groups by Elsevier takes up to 2 weeks and this functionality was recently exceptionally unavailable during several weeks.

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